Voice Recognition & Realtime Technologies for Stenomask Court Reporting

SJI

A State Justice Institute Funded Demonstration

Project Evaluators: University of Missouri-Columbia

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Acknowledgements

Special thanks goes to the three pilot reporters for their hard work and dedication to this project. Many hours of personal time were devoted to their efforts in testing and evaluating this technology. The pilot reporter's judges are also owed special thanks for their patience and assistance in this process. They were:

29th Judicial Circuit

Sharon Lambert, Court Reporter

The Honorable David C. Dally

16th Judicial Circuit

James Bouck, Court Reporter

The Honorable Ronald R. Holliger

28th Judicial Circuit

Mike Zajdel, Court Reporter

The Honorable David Darnold

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Voice Recognition and Realtime Technologies for Stenomask Court Reporters is a grant project funded by the State Justice Institute (SJI). The SJI awards grants to improve the quality of justice in state courts and to foster innovative, efficient solutions to common problems faced by all courts. One of SJI's key areas of interest includes the study of the application of technology in courts. This grant's purpose was to evaluate the effectiveness of voice recognition technologies for stenomask court reporting. This was accomplished by purchasing three SpeehCAT Systems from AudioScribe Corporation and utilizing three Missouri court reporters in jurisdictions of various sizes to test the equipment in actual court settings. The overall goal of the project was to reach realtime certification using this new technology, a goal never before obtained by any stenomask court reporter.

The project began by sending the three reporters to training on the new systems. After three days with the manufacturer, they returned to their respective courts to begin self-training the software on the recognition of their voices. After a few months, the Office of State Courts Administrator, in conjunction with the evaluation plan, began testing the ability of the systems to reduce transcript preparation time. Using state-standardized tapes, baseline and SpeechCAT methods for transcript production were evaluated. The results of this component of the evaluation, although very encouraging, are statistically insignificant due to a lack of a sufficient data for analysis.

Another component of the evaluation was the realtime certification of the reporters. There had never been an attempt to obtain realtime certification using this technology or by a stenomask reporter until this pilot demonstration. At the conclusion of the project, one of the three pilot court reporters, after having the equipment for less than a year, was able to obtain realtime certification. Jim Bouck from the Jackson County Family Court in Kansas City, Missouri was able to become the nation's first realtime certified court reporter. The other two pilot reporters, Mike Zajdel and Sharon Lambert, both came incredibly close to obtaining the realtime certification. Finally, the actual multimedia realtime testing of the system in an actual court proceeding was conducted in December 1999. The findings of the focus group discussion following this live demonstration found significant apprehension and excitement about the technology. There was some concern with anything less than 100 percent accuracy, which may or may not be a realistic goal. The project demonstration was a national success due to the realtime certification achieved.

STENOMASK COURT REPORTING - BACKGROUND

The history of court reporting has deep roots. According to the National Court Reporters Association, in the 4th Century B.C., a system of shorthand was used to record the speeches of Cicero and other Roman leaders. Modern shorthand began in 1913 with the introduction of the stenotype machine. The stenotype system captures the sounds of words in a phonetic code with each line of characters usually representing one sound or syllable. Today, the stenotype machines are enhanced with new computer aided transcription technology.

According to an article entitled "The Genesis of Stenomask Voice Writing," this system of court reporting was born in Chicago in the early 1940's. The article was written by Horace Webb, the creator of the stenomask. Rather than re-dictate shorthand notes for transcription, the concept of repeating each spoken word in court into a microphone just as it was spoken came into being. It further developed in the U.S. Congress and finally, the birth of the stenomask system truly occurred in the U.S. Navy. The Navy decided to evaluate all known systems of court reporting and to recommend one for the Navy to adopt. The Navy selected the stenomask method and established a school to train military personnel as court reporters.

Interestingly enough, two of the three court reporters in this SJI demonstration trained in stenomask reporting during their years in military service. Now, for the first time, stenomask court reporters can become realtime proficient with new technologies for voice recognition. Like stenotypists, computer aided technologies have come to stenmask reporters. The stenomask reporter is the ideal candidate for voice recognition systems since software limitations prefer to recognize a single person's voice.

PROJECT ORIGINS

In early 1997, Missouri's statewide court automation efforts were just beginning to materialize. A stenomask court reporter, Michael Zajdel contacted the Office of State Courts Administrator (OSCA) with an idea. That idea was to allow a stenomask court reporter to evaluate the potential for voice recognition technologies in court reporting as a component of the statewide automation efforts. In November 1997, the State Justice Institute (SJI) received a concept paper on the idea and in May 1998, a full application was submitted to SJI. Subsequently, a grant contract was awarded and the project began in October 1998.

The grant was originally to last from October 1998 until September 1999. However, an additional three-month extension provided by SJI extended the grant until December 1999.

PROJECT GOALS

- Demonstrate the effectiveness of the latest technology in voice recognition software specifically designed for stenomask court reporters.

- Serve as a national demonstration for stenomask reporters to become realtime proficient (with the underlying desire to have realtime certification to help state courts meet Americans with Disabilities Act requirements for hearing impaired individuals).

- Increase efficiency in transcript preparation.

- Create a resource manual for other court personnel interested in voice recognition technologies.

EVALUATION METHODOLOGY

The evaluation plan approved by the SJI included several components. A team of two independent evaluators from the University of Missouri in Columbia worked in conjunction with staff from the pilot sites and the Office of State Courts Administrator to ensure the validity of any findings. The following are the evaluation components and methodology used in this project:

TRANSCRIPT PREPARATION

The court reporters participated in a series of tests to determine increased or decreased transcript preparation time because of this technology. One project hypothesis was that transcript preparation time declined because there would not be a need to type the transcript. Rather, the text merely needs to be proofread.

The Supreme Court provided standard tests. They were former certified court reporter examinations. Each tape included three five-minute segments of dictation. The tests included a literary segment at 180 words per minute, a medical question and answer segment at 200 words per minute and a general question and answer segment at 225 words per minute.

Initially, each time the court reporters were tested, they took a baseline test and a test using the new technology. This would allow a comparison of transcript preparation time between the baseline method and the voice recognition method. The dates and findings of these tests are included later in this paper in Table 1. The court reporters listened to the five-minute segments and were timed for completion of the transcript after each five-minute segment for both the baseline method and with the voice recognition systems.

SURVEYS OF PILOT COURT REPORTERS

The pilot court reporters were required to track several issues throughout the grant period. After considerable evaluation, it was determined that any attempt to summarize this information would result in a loss of knowledge. These survey responses have been included in their entirety with the reporters names removed.

SURVEYS OF PILOT COURT JUDGES

These surveys captured the pilot court reporters' supervisors (judges) thoughts and concerns regarding the use of this technology in their courts. These were summarized and are included later in this paper.

LIVE TESTING OBSERVATIONS AND FOCUS GROUP RESULTS

Through direct observation and discussion of the systems' benefits and detriments, this portion of the evaluation helped bring the systems multimedia potential into view. A live demonstration of the systems multimedia potential took place in the Jackson County Family Court at the end of the grant period. It is important to note that the systems were used in court proceedings throughout the demonstration project. However, this particular component of the evaluation projected the text of the proceeding, realtime, as the court was in session. The case was a termination of parental rights case and therefore a copy of the transcript was confidential and is not available as part of this evaluation. However, the focus group that followed this live testing included the judge, the attorneys and guardian ad litem for the child, court observers and staff from the Office of State Courts Administrator. The findings of this focus group appear later in this paper.

REALTIME TESTS

These nationally recognized tests are the ultimate outcome for this grant – realtime certification. The pilot participants attempted the realtime

certification on more than one occasion. The results are included here along with a brief summary of the certification process.

FINDINGS

Following the methodology described above, the findings of these various components below illustrate the independent findings for each element of the evaluation.

TRANSCRIPT PREPARATION

<u>Transcript preparation time under controlled conditions.</u>

The data presented in Table 1 shows the dates and times for each test by court reporter. The message one obtains from the data is that it appears that the new method requires less transcript preparation time. However, additional experimentation needs to occur before the hypothesis, that a reduction in transcript preparation time results, can be quantified and found to be statistically valid.
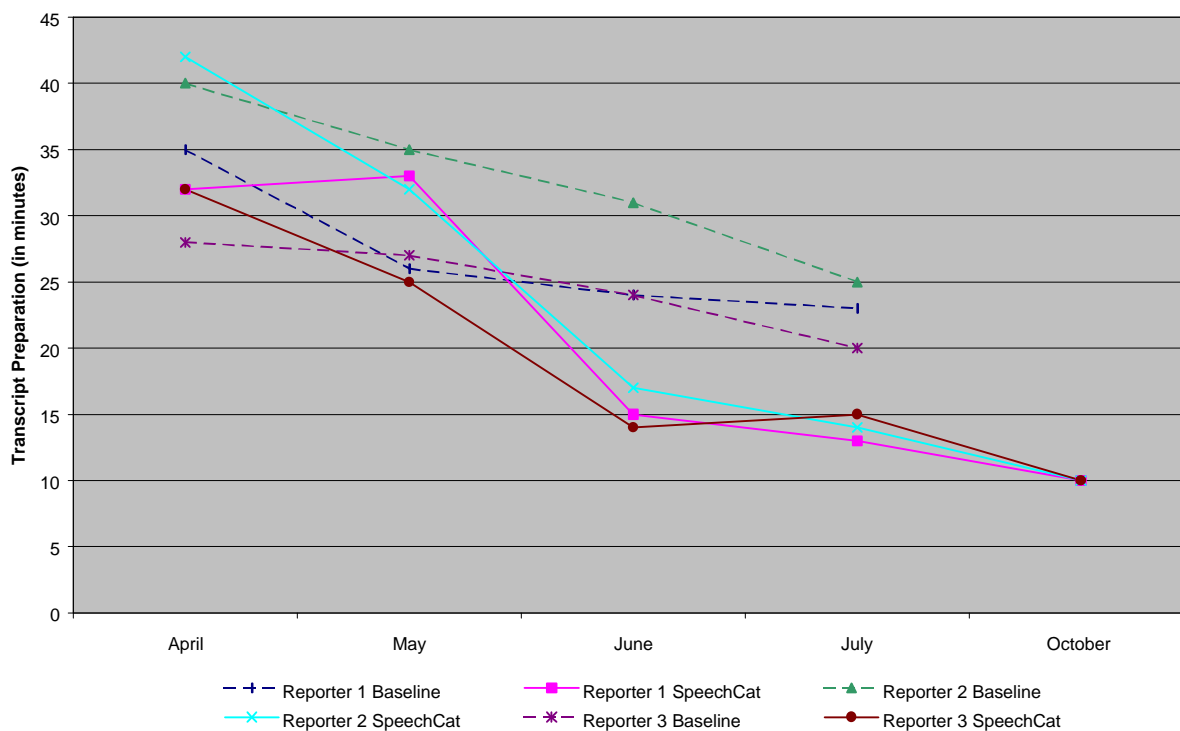
Since the three pilot reporters that participated in the experiment may be considered three of Missouri's best stenomask reporters, other reporters with a wider range of capabilities need to be included in future experiments. In general, it appears that faster transcript times included more errors, although this also requires further investigation. It would be desirable to be able to conclude that the new method results in shorter transcript preparation time and fewer errors. From the preliminary work already completed, it appears that this will eventually be the case but more statistically conclusive work needs to be conducted.

As stated above, Table 1 contains the results of the standardized testing. The numbers in the table are the preparation times. The numbers in parentheses are the numbers of errors. The charts contain line graphs of the times under the new system and under the old at the various transcription speeds. This allows some direct comparisons to be illustrated. For example, you can see what appears to be a significant increase in transcript preparation time for the 180 word per minute (wpm) test when comparing the old and new methods for each of the three court reporters. You can also see a learning curve appears to be present since transcription preparation time appeared to improve over time. However, as you can see, the increases in transcript preparation time tend to fall at the 200 and 225 wpm range.
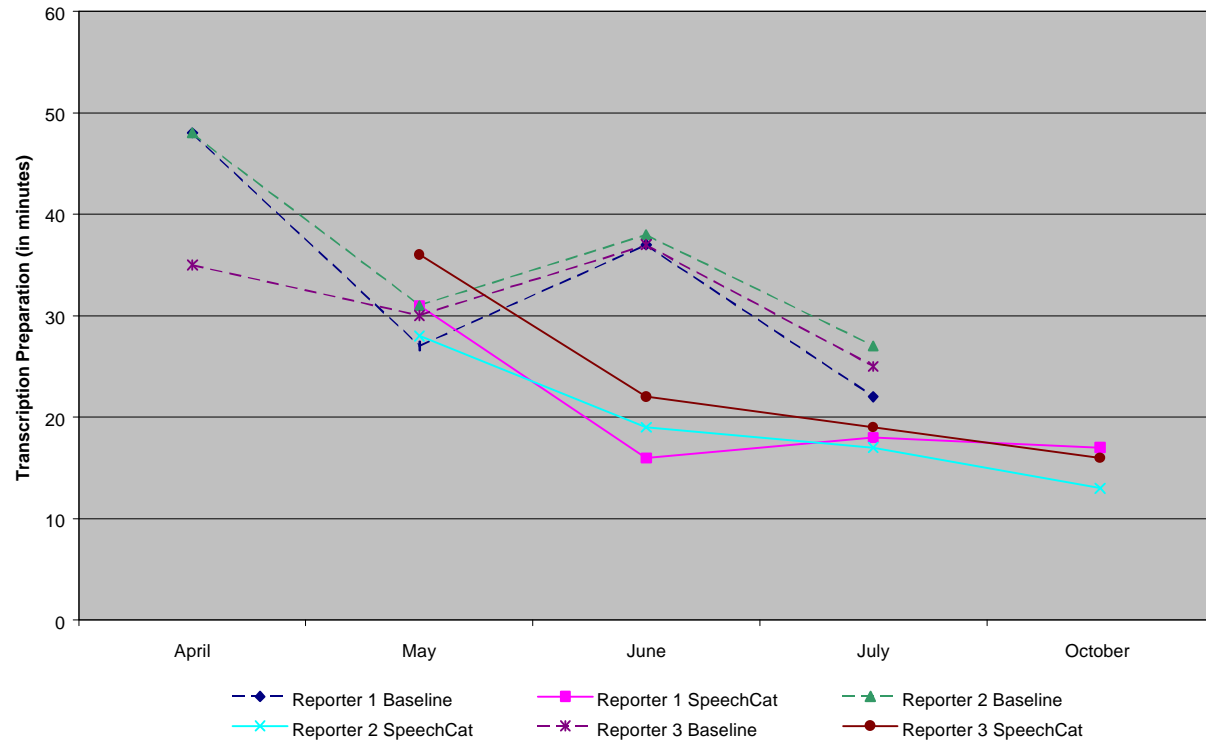
Table 1   Transcript time in minutes and (number of errors) for standard tests

Date	Pilot Reporter	Baseline			SpeechCat		
		180	200	225	180	200	225
4/23/99	1	35 (8)	48 (19)	55 (20)	32 (7)		
4/23/99	2	40 (11)	48 (35)	35 (30)	42 (38)		
4/23/99	3	28 (2)	35 (8)	38 (9)	32 (6)		
6/4/99	1	26 (0)	27 (4)	28 (5)	33 (11)	31 (9)	41 (10)
6/4/99	2	35 (6)	31 (18)	31 (24)	32 (30)	28 (26)	41 (29)
5/26/99	3	27 (2)	30 (0)	31 (11)	25 (17)	36 (18)	38 (18)
6/24/99	1	24(4)	37 (6)	29 (24)	15 (19)	16 (13)	27 (27)
6/24/99	2	31 (18)	38 (19)	37 (25)	17 (49)	19 (38)	31 (37)
6/25/99	3	24 (4)	37 (6)	33 (32)	14 (9)	22 (4)	27 (5)
7/23/99	1	23 (2)	22 (10)	27 (10)	13 (15)	18 (28)	25 (67)
7/23/99	2	25 (35)	27 (41)	39 (52)	14 (30)	17 (35)	21 (44)
7/23/99	3	20 (3)	25 (4)	30 (9)	15 (3)	19 (9)	26 (11)
10/15/99	1				10 (32)	17 (53)	23 (29)
10/15/99	2				10(32)	13 (46)	10 (48)
10/15/99	3				10 (7)	16 (8)	23 (10)

180 WPM Certified Court Reporter Exams

200 WPM Certified Court Reporter Exams

Legend: Reporter 1 Baseline, Reporter 1 SpeechCat, Reporter 2 Baseline, Reporter 2 SpeechCat, Reporter 3 Baseline, Reporter 3 SpeechCat

225 WPM Certified Court Reporter Exams

Legend: Reporter 1 Baseline, Reporter 1 SpeechCat, Reporter 2 Baseline, Reporter 2 SpeechCat, Reporter 3 Baseline, Reporter 3 SpeechCat
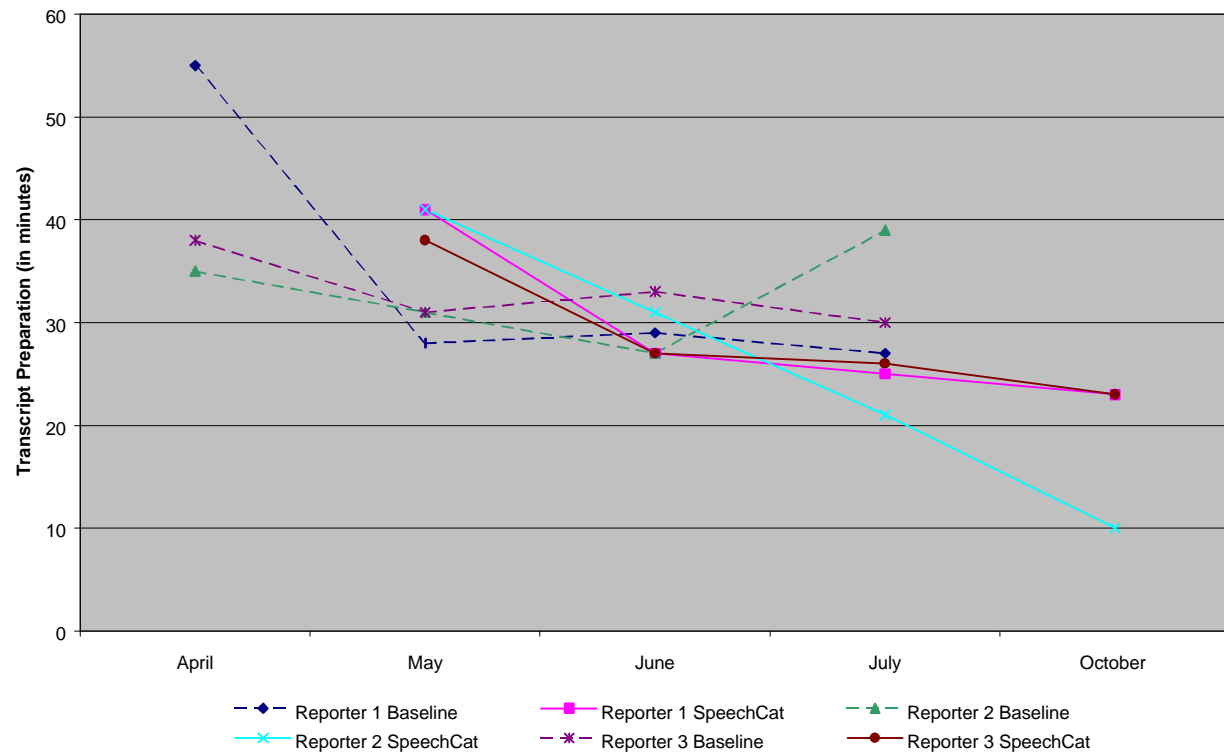
The following are the actual survey responses from the three pilot court reporters:

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1.   a.) Did your initial training at Audioscribe on the SpeechCAT system prepare you to return home and use the system?

Reporter 1:   It was a good start. The training went through the basics of what we needed to know to get started. We had to build on that when we returned home and began using the system. There is a great deal to know, and the initial training was more a familiarization with the whole system than in-depth usage.

Reporter 2:   Three days of training was adequate for familiarization with the CAT system and its use for a person with moderate computer experience. There were some software issues that were not resolved during training, but subsequent support calls satisfactorily clarified issues.

Reporter 3:   The initial training was three days in length and covered most of the fundamentals required to begin training the system. All three site participants felt that in order for us to return home with a complete understanding of all aspects of the system, the training could easily have been five days in length.

b.) What were the strengths in the training?

Reporter 1:   Hands-on use to become familiar with equipment. Small number of people being trained (3) with one instructor. Lots of individual attention.

Reporter 2:   Hands-on, on-site training, having personal instruction. AudioScribe's expertise in speech recognition and CAT systems helped accelerate the learning curve.

Reporter 3:   1.) The training class was made up of just the three site participants, one instructor, and one instructor's assistant, and so the training was very much hands-on and one-on-one.

2.)   Immediate answers were forthcoming to any questions, and the instructor was able to pay particular attention to any part of the training that the participants felt was, or might be in the future, a problem area for them.

3.)   The training days were lengthy, beginning at 8:30 a.m. and continuing until 6:30 or 7:00 p.m.

4.) A comprehensive manual was provided to each participant. It was compiled chronologically, and so was a perfect agenda for the training program, and kept the training on track and to the point.

5.) The personnel and facilities were top-notch.

c.) What were the weaknesses in the training?

Reporter 1:   Time. Not enough of it for full training. Certain aspects took a long time to accomplish; e.g., setup of templates and layouts. Some of these difficulties, such as setting up RTF codes, I understand were to be incorporated into the software so they would not be so time-consuming in the future.

Reporter 2:   Too much information vested in too few individuals created an information bottleneck. Because the programmer who wrote CAT software was not available during our training, some questions could not be answered without his presence.

Reporter 3:   1.) The computer software was so new that the instructor had some problems in being able to lend true assistance to the participants with regard to portions of it. Some aspects of the system just did not behave as designed and, at this time, many of those aspects have been deleted from current versions of the software, thus, making that portion of the training totally useless at the present time to the participants.

2.) The above-described problem caused the participants to have to spend much time upon their return home in figuring out certain aspects of the software. Most of this was finally accomplished by trial and error, but some aspects of the software have just never been capable of functioning as designed.

2.   a.) What were the problems (if any) in the technical aspects of the software?

Reporter 1:   This answer is for both software and hardware, as the distinction is sometimes not clear as to where the problem originated. I have had a number of problems that have been difficult to diagnose. My system was upgraded in November, but problems persist. It has been suggested that I may have a bad memory chip. Plans are underway to present the system to AudioScribe again in the near future for diagnosis and repair. Whatever is causing the problem, the symptoms

are sometimes bizarre. For example, I first noticed difficulties in March of 1999 when I was unable to save speech files after doing vocabulary building. The end result, after weeks of attempting to diagnose the problem, was that I had a corrupted vocabulary. No one knows what caused the corruption. I had to start over building a vocabulary from scratch and deleting one in which I had made over 3,000 custom entries. I continued to have problems, and at national convention in August, one of the AudioScribe people deleted everything off my hard drive and reinstalled my software. I used an AudioScribe system for the realtime test and did not have my own vocabulary available. This did not fix the system. AudioScribe was present at the Missouri convention in September and attempted further adjustments. In November, the system was upgraded, but the problem persists. It sometimes manifests itself on the monitor screen as a series of random letters and numbers with no spaces between. There are other manifestations such as slow response time and poor recognition in spite of clear dictation. The other two reporters have not experienced the same problems, so it keeps coming back to something in my system. I call it a gremlin, but I expect there is a more technical term out there somewhere. The result has been that I have not had as much success at building recognition as have the other two reporters. I hope to have the problem fixed for good soon and then be able to catch up. With the recent upgrade, I expected similar results to what I experienced in August on a system identical to what I got with the upgrade. I have yet to achieve those results. I have once again started from scratch building a vocabulary. This is very time-consuming.

Reporter 2:   Due to relatively new development, bugs often surfaced and caused frustrating situations. Earlier versions of user interface created difficulty in getting formatted templates to work properly. Writer software uses up system resources and has too many features that cannot be turned off, which results in sluggish system performance and reduced recognition accuracy if formatted realtime feed is needed or desired, especially with broad topics and higher rates of speech.

Reporter 3:   1.) SpeechCAT automatically inserts line, page, and section breaks in the text document. This is done so that automatic formatting and indexing of a completed transcript may take place. The problem is that the breaks are inserted before final proofing of the transcript occurs, and so editing changes made after the insertion of the breaks throw off page numbering and cause formatting errors that are fairly complex and time consuming to correct.

2.) In the same portion of SpeechCAT described above, certain formatting is mandated by the software and cannot be changed. Unless you are willing to accept the formatting the software prescribes,

you must again make rather complex and time-consuming changes, which defeats the purpose of templates and automatic formatting.

3.) The above-described problems were resolved by my creation of a macro that automatically strips from the text document the very breaks and formatting that SpeechCAT installed, and these portions of the software are being deleted from its most current version.

b.) How did the technical support staff address these problems?

Reporter 1: Good tech support by phone, dial-in, in-person assistance when available at conventions. I've had a lot of tech support from several people at AudioScribe in an attempt to diagnose and correct different problems with software and hardware.

Reporter 2: They have been continually updating their software, attempting to modify and add software features, which has resulted in a more robust package that continues to develop rapidly. They have always requested user feedback to aid in further development and improvement of their products.

Reporter 3: 1.) Some of the problems were incapable of being addressed through any manner other than programming. The software was so new, it had glitches that AudioScribe was unaware of before we brought them to their attention. They found that the study participants were not so willing to change transcript formatting simply for the ease of automation. As I said, most of these original problems have been dealt with by AudioScribe as a result of feedback from their users.

2.) The original SpeechCAT software has now been broken down into several layers of software that may be purchased separately, allowing the user to bypass those portions that do not allow them to produce transcripts in their preferred way.

3.) The newest versions of the software allow editing to be done directly in WordPerfect or Microsoft Word. This allows the user to take advantage of the automatic indexing available through those respective softwares.

3. a.) Did you experience any hardware problems? (Yes or No) _____ If yes, give a brief description of each problem and give an estimate of the number of days (or hours if less than a day) required to fix the problem.

Reporter 1: See answer to #2 above

Reporter 2: Yes. Lost keyboard over weekend, but was allowed to open case to check connections after calling in. Once permission was received to

open case and investigate, a simple cable connection problem was corrected within an hour. The problem again repeated itself and was repaired on site during a break in proceedings, and has not happened since.

Reporter 3: Yes. I have enclosed a copy of the AudioScribe work order. It is concise and to the point. Shipping of the equipment to and from AudioScribe was prepaid by them, and I was without the equipment for five working days. As reflected in the work order, they also upgraded the SpeechCAT and Dragon software while the equipment was in their possession, and all worked perfectly well when returned to me.

b.) Did technical support give adequate support?

Reporter 1: See answer to #2 above.

Reporter 2: Very good.

Reporter 3: I cannot stress this point strongly enough. I have found the technical support, both as it relates to software and hardware, to be excellent. Time and money do not seem to be a barrier to making the user a satisfied customer. AudioScribe has even employed many of the study participants' suggestions in their newer versions of their software and hardware.

c.) What did the technical support do to fix the problems?

Reporter 1: See answer to #2 above.

Reporter 2: On numerous occasions AudioScribe responded to requests for assistance immediately, and even spent numerous hours on weekends and evening hours to help accommodate me when I was having problems.

Reporter 3: This is also noted on the enclosed AudioScribe work order.

4. What was involved in the learning curve and self-training with these systems? For example, did you find new and improved ways of increasing your voice recognition over time?

Reporter 1: A lot of trial and error until finding the right combination, discarding of methods that did not build recognition.

Reporter 2: The learning curve with speech recognition software was quite steep, but it has become more accurate and easier to use in a short time, which will shorten the learning curve for new users. Over time, my method of increasing voice recognition still continues to evolve, and I am still refining the way I train both myself and the system to increase

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speech recognition. When we first started the study, often there would be no clear answer to questions, so I would attempt to try something on a theory and interpret the results, or discuss problems on user forums on the internet. Because the more recent versions of the software have responded more rapidly to training, we now can more easily tell when improvement is or is not being made, whereas in the beginning it was sometimes hard to tell.

Because of the rapid development of speech recognition software and the numerous software changes that have come about, I have had to spend much time just keeping on top of numerous minute issues that affect not only the speech recognition software in general, but the way it affects the CAT software that I use as well. The rapid rate of change has made implementing CAT system features confusing at times, and there are also times when even the speech recognition companies are of little help. Often the CAT software updates will respond to a change in the speech recognition software and make a change in the CAT software that I was not aware of, sometimes forcing me to call for assistance with CAT software features I once was already familiar with. I do not see the rate of change in this area slowing any in the immediate future.

Reporter 3: 1.) The SpeechCAT software is relatively straightforward and easy to learn. Except for the templating problems mentioned above, I found nothing overly difficult about learning the various facets of the software and making them perform adequately. As explained above, these problems seem to have been corrected by AudioScribe and should not be a problem to the users of new versions of their software.

2.) The Dragon software has one inherent problem and that is the inability to save a text file with the audio file attached to it. Once the text file is closed, the audio is lost. This affects tremendously the ability to train the software to the user's voice.

A.) Training of the speech files is relatively simple. Without closing the text file, the text is simply corrected so that it is identical to the spoken words contained in the audio file attached to it. The user is then prompted to save speech files. Each successive saving of the speech files after employing the above method causes a quantum leap in voice recognition. Obviously, finding time available to do the training before closing the text file is imperative and drastically limits the amount of training that can be done at given times.

B.) The study participants have found that our dictation styles have changed greatly for the better. Words must always be

spoken in relatively the same manner and at the same speed. This is not difficult, but does require the court reporter's total attention to detail.

C.) The study participants have also found that one-syllable words have a much greater chance of being misrecognized. It would seem to make sense that the less information available to the processor would cause greater problems with recognition. We have, therefore, created a large list of custom phrases in the vocabulary editor, i.e., we were, I was, she is, etc. These strings of one-syllable words now take on the character of multiple-syllable words and do much to improve recognition. They are all generic in nature and so may be used in any vocabulary. The custom phrase list now contains several thousand entries. It should also be noted that greatly improved recognition also causes better recognition of these one-syllable words. So while the custom list was necessary in causing improved recognition during the initial training of the speech files, it is becoming apparent that we are adding fewer and fewer entries to the list over time as recognition improves.

5. **How long did you spend with the system before you began to notice a benefit in:**

   a.) Realtime?

Reporter 1: I'm not sure I can say I'm doing realtime at this point.

Reporter 2: About three months, but minimal success at first due slow acceptance in this rural area and unchanged court practices.

Reporter 3: 1.) During the first approximately six months, the only realtime application was in reading back portions of the testimony during the proceedings. The recognition was not 100%, but was certainly good enough to allow the reporter to accomplish this task with no great problem. The Court and attorneys like this improved ability very much and their requests for it have increased over the study period.

2.) The term "realtime" has many definitions; however, it should be understood that to the individual reporter the concept of realtime centers around the quality of recognition that the reporter receives immediately upon repeating the words spoken during the proceedings. If the immediate recognition rate is 96% or better, it is deemed appropriate for a realtime feed to the litigation participants. A recognition rate lower than 96% may not be deemed appropriate for a realtime feed, but the better the recognition, the better the court reporter is going to perform in all aspects of his or her work. The point

is, pursuing 100% "realtime" recognition is, or should be, the goal of anyone using this system.

3.) That being said, somewhere around eight to nine months into the study, this participant began receiving the 96% or higher recognition rate, depending upon the circumstances, that is required for a realtime feed. This is the period during which the Judge was able to view the notes on a realtime basis and use them to his benefit in making rulings or supplementing his notetaking.

b.) CAT?

Reporter 1:   Maybe a few months. The quality of the recognition depends on the type of hearing and the speed of the proceedings. That in turn affects the amount of time spent editing. It has become a very usable tool for transcript production.

Reporter 2:   I immediately began producing transcripts by dictation with higher speech recognition accuracy than before receiving my CAT system, when I was using a less powerful computer and older version speech recognition software and/or transcribing manually without scoping tools.

Reporter 3:   1.) The term "CAT" stands for "computer-aided transcription." Within the meaning of that term, this participant has performed exclusively CAT services for the Court and litigants since the day the equipment was received. During the first six months, that was accomplished by redictating the proceedings, then editing and saving speech files, and then printing the final text file. Because redictation is done at a somewhat slower speed than realtime dictation, this was beneficial to voice recognition in the early stages of speech file training.

2.) After approximately six months, the realtime recognition received by this participant during in-court proceedings allowed him to forgo redictation and simply correct the text file made during the actual court proceedings and then print. As you can imagine, this has shortened tremendously the amount of time currently being spent in transcript production. As the realtime recognition has increased over the last six months, the time for transcript production has continued to drop.

3.) A realtime demonstration was held in the Jackson County study site on December 9, 1999. This consisted of a realtime feed of a juvenile court matter that was approximately sixty minutes in length. At the conclusion of the demonstration, this participant corrected the text file of that sixty-minute hearing in approximately forty-five minutes. Since the length of correction time was less than the time to actually realtime the proceedings, this would seem to imply that if the realtime

feed were being sent to a scopist doing the corrections on a realtime basis, a perfect realtime feed could be sent from the scopist to the litigation participants in almost the same time that the "dirty" realtime feed could be sent to them. A demonstration of this type would be my suggestion for the next demonstration of realtime in the courtroom.

4.) The current ability to correct sixty minutes of realtime text file in forty-five minutes would seem to prove the usefulness of the system on a CAT basis, but, as stated above, the goal of any court reporter using the system should be pursuit of 100% realtime recognition. Unless the reporter is receiving 90% recognition or above, I don't feel the transcription time by CAT, versus the old transcription manner, would cause a tremendous time savings.

6.   Did you experience any system-related problems in attempting to use the equipment in live court proceedings? (Yes/No) _____ If yes, briefly describe the problems.

Reporter 1:   I tried using Writer, which gives an attractive, fully formatted typical transcript look to the text on the screen. Unfortunately, it also uses system resources to do this and adversely affects recognition. The result was poor recognition and very long response time, lagging two minutes or so behind the speakers, who were rather slow.

Reporter 2:   Yes. I consider the older, traditional style microphone that was initially given with the CAT system a system-related problem because I got such poor recognition with it. After seven months, I tried to use an alternative microphone inside the mask, and got better results immediately.

Reporter 3:   Yes, only one. Stenomask reporters are taught to provide verbatim reporting skills while remaining totally silent in the courtroom. The Dragon software and the sound cards employed in the hardware have forced me to raise the level of my voice somewhat to gain the best recognition. Although this did not disrupt the proceedings appreciably, it was something that this participant felt needed change. Approximately six months into the study, a digital microphone was installed in my Stenomask, and this has allowed me to lower my voice greatly, though still not back to the pre-system level. Audioscribe's current systems employ not only the digital microphones, but also USB technology. This seems to have cured the "noise" problem, if there was one. Also, the grant participants intend to explore digital array microphones in the near future as a way of again enhancing recognition while even further reducing our voice levels.

7.   List specific issues related to your pilot sites that may have affected your performance of these systems or your ability to work with them?

Reporter 1:   Mine is a general assignment, hearing criminal, civil, domestic, and juvenile cases and occasional small claims appeals. Subject matter is thus unrestricted. In spite of repeated requests, it is often impossible to control the speed of people's speech habits. Rate of speed is perhaps the most critical factor in good speech recognition. Both the wide range of subject matter and fast speed (over 200 wpm) adversely affect performance. When the speed is reasonable and/or the subject matter leans toward technical or legal areas, recognition improves noticeably.

Reporter 2:   a) CHANGE IN COURT REPORTER'S PRACTICES: I have made changes in the way I do things which have been considered negative, and have been attributed to the pilot project and the new system I am utilizing. It is true that I, as a voice method court reporter, have not attempted to control the courtroom environment as much as I have recently, but this is because before speech recognition was in place, my situation was different. I believe that, although my opinion may appear to be slightly subjective, the changes in behavior and practice that I have made are actually correcting counterproductive courtroom practices that never were practical. The changes I have made are:

✓ I try to slow the rate of proceedings down when speakers talk at speeds in excess of about 240 words per minute,

✓ I immediately stop parties from speaking simultaneously, and

✓ I insist on being able to hear everything, even if I know there is a backup microphone in front of the speakers.

I used to tolerate all of the above courtroom errata to varying degrees. To fully understand my reasoning for the changes, one must first know how things were previously done and then make a comparison of the methods.

The old way: A reporter created a record by dictating into a closed microphone connected to a high-quality audio tape recorder. The reporter first identified the speaker and then repeated verbatim what was said. Voice reporters often took pride in their ability to "handle" frenetic courtroom situations, reaching rates of speech as high as 300 words per minute. No dictated punctuation was necessary, because the reporter or a transcriptionist would go back and listen to the reporter's voice again and manually type a transcript, adding punctuation and formatting as necessary after the fact. When proceedings were very fast and uncontrolled, the person creating the record would often have to replay portions of the audio tape numerous times to finally understand portions where

the reporter was either speaking very fast or stammered because of misunderstood phrases due to multiple parties speaking or not hearing well.

Pro:

- ✓ No prior preparation was necessary for a skilled reporter; he or she could simply enter a room and begin.

Con:

- ✓ Transcript production was slow and tedious.

The new way: A reporter still must first identify speakers and then repeat verbatim what is said. The reporter now dictates into a closed microphone connected to a computer that converts the signal to digital format, which in turn is simultaneously interpreted and converted to text by speech recognition software and saved to a long-term storage medium, such as a hard drive. There are modifications in dictation style necessitated by the now realtime system capabilities, so the reporter dictates as much audio information as is possible without overburdening the speech recognition system and/or dictation accuracy. Depending upon numerous factors, the realtime speech recognition accuracy can range between 100 percent accurate to totally unintelligible.

Pro:

- ✓ A draft record is immediately available, giving access not only for parties but for hearing impaired communities as well.

- ✓ Digital format allows electronic time stamping to be done, allowing for perfect synchronization of audio, video and captioning.

- ✓ Post-trial record preparation is much less stressful for the reporter and can be accomplished much faster.

- ✓ Even if realtime recognition is lower than ideal, as long as digital recording was made, faster turnaround than with manual method of transcription is still often possible.

Con:

- ✓ Greater preparation effort is required before hearings to obtain best results.

✓ State of the art technology will not tolerate sloppy dictation styles.

✓ Higher initial costs due to state-of-the-art equipment requirements.

✓ Will not yield good realtime results in frenetic environment.

✓ Training required of all participants for successful implementation.

Because the grant project has caused me to critically evaluate the way that I have been working in the past as well as how I will work in the future, I have concluded that I was making concessions that sacrificed not only the quality of my record, but of my own well being as well. The changes I have attempted affect will be made regardless of what technology I am using to produce records from now on.

b) COURTROOM ENVIRONMENT: This category is related to subparagraph (a) but needs specific addressing. I work in four separate courtrooms, each having its own problems, and none of which are good acoustically. There are even two courtrooms where I have to stand up to even see the parties and hear the judge at the same time. Even before the grant project began there were problems regarding these areas, and the new systems have only amplified the need for an improved work environment.

c) TRAVELING: Traveling and working out of four different courtrooms creates a situation where I have not been able to train my speech recognition system in an efficient manner. To train speech recognition software properly, recognition errors must be corrected or it will not become more accurate. Because I must shut down my system and leave once we are finished in three of the four courtrooms I work out of, I have had to compensate by utilizing my personal time to achieve a satisfactory level of recognition through training. I do consider this to be time well spent.

The systems we purchased were not equipped to make both a realtime record and record digital audio due to cost factors involved, so I had to choose which method to use for each courtroom situation. I chose to do realtime for all routine proceedings and digitally record trials, because trials are much more likely to need a transcript produced than routine matters, and having a digital audio recording allowed me to produce more accurate transcripts afterwards. I saw it best to try to accommodate faster transcript production on trials and have unedited transcript available for reference on routine matters.

This matter will become moot because CAT software systems either now have or will have both capabilities built into their systems.

d) RESISTANCE TO CHANGE: If there is one single factor that can be considered an insurmountable obstacle, resistance from a judge is it. Judges can be territorial in nature, and accommodating change might be perceived as an unnecessary encroachment into their domain. The judge is the single most powerful person in a courtroom, controlling the entire room with just his/her presence. The attitude the judge has during court sets the tone and standard for all to adhere to. If a judge doesn't facilitate change, it will not come. Likewise, if a judge is not willing to accommodate the changes required to make a new system work, the system will fail. In fact, it is conceivable that some may even create situations that will set a system up for failure in order to eliminate it and return to the status quo.

If a judge's reluctance to CAT and/or realtime capability has a basis, it may be based on what I would call the "what if" factor, of fear of attorneys repetitively stopping for the reporter to read back during arguments between counsel, and of parties having access to information that would create an argumentative environment of "who said what," and of prolonging trial times to the point of absurdity due to the ability to critically review statements made during proceedings at the end of each day. I personally do not consider these concerns to have a verifiable basis, since proceedings will always be controlled by the judge. I believe resistance to change is more probably due to not wanting to change a system that is already working.

For many judges, the changes required, if any, for their reporters to utilize these systems will be unnoticed and, in fact, welcome. The amount of change needed will vary on a case-to-case basis, depending upon what type of reporting the judge already uses and the practices enjoyed by each court. For those who have become accustomed to a voice reporter who has catered to them by allowing the situations spoken of in 7(a) above, change may be slow in coming, with more negative repercussions than good. For now, it's safe to say that if a judge does not want to utilize and develop speech recognition CAT technology in his/her courtroom, it would actually be cruel to the court reporter to ask them to utilize these systems.

Reporter 3:   1.) This grant participant has had a juvenile court assignment from the inception of the grant process. The very nature of the assignment has allowed for more structured courtroom proceedings, the absence of any juries, and a considerably smaller transcript load than the other grant participants.

2.) The structure of the proceedings and the inherent nature of its limited vocabulary has allowed for more fine-tuned vocabulary editing and building, which does much for improved recognition. The absence of a jury means that jury selection is not required. The voir dire process has historically been a stumbling block for realtime reporting because of the increased number of speakers, which could range up to 100 at times, and the wide array of subject matter covered in the jury selection process. Obviously, many terms spoken by prospective jurors would not even be in the current vocabulary, no matter how much vocabulary building was done. The smaller transcript load has allowed this participant to spend relatively more time training speech files and improving recognition.

8.   How has the system affected transcript preparation time?

Reporter 1:   It has reduced transcript preparation time by eliminating initial typing. Editing time has increased, depending on the quality of the initial recognition. Overall, the effect has been a reduction in transcript preparation time.

Reporter 2:   For every trial I have transcribed, it has significantly reduced the amount of preparation time, and, at times, significantly reduced physical and mental stress. For routine matters before the court, it has been nearly as slow or slower due to lack of cooperation.

Reporter 3:   Greatly, for the better. I would refer you to the answers to question 5 above, and also to the results of the evaluation testing done by the grant participants.

9.   During your realtime tests, what issues may have positively or negatively affected your scores? (MCRA test, NVRA test in North Carolina & NVRA test in Georgia)

Reporter 1:   8/99 NVRA test NC. Due to problems with my system outlined above, I used AudioScribe system for this test, which had USB technology and faster processor. After 2-4 hours training and not having my own vocabulary, I placed 3rd with 89+. The newer technology had a positive effect, although my own system was then approximately at the same level after eight months of work.

9/99 MCRA test MO. Further problems made me decide to once again use the AudioScribe system, since it was available at the MCRA convention. This was not a good decision and probably negatively affected my score. I was not familiar enough with the different aspects of that system and made some mistakes in operating it, which caused unnecessary errors.

11/99 NVRA test GA. This test was shortly after my system had been upgraded. I was in the process of rebuilding my vocabulary and had not progressed sufficiently for effective testing. The upgrade was to make my system identical to the AudioScribe system, which had given me such quick results in NC. Unfortunately, my upgraded system did not behave the same way. (See answer to #2 above.)

Reporter 2: Prior to the first NVRA Realtime Verbatim Reporter (RVR) exam in August 1999, based on my own testing I knew my realtime records were not accurate enough to pass a realtime certification examination. I believed part of the problem was related to the microphone I was given to use in my mask. To remedy this, I installed a new microphone in a mask in an attempt to increase recognition accuracy only two days before leaving town before the test. The results I got were so good that I decided to use the new mike for the certification test. I had prior commitments that had me out of town for two weeks prior to the exam, however, and I overlooked some dictation issues, which caused a consistent misrecognition during testing for my Q&A formatting, which resulted in numerous errors. A recalculated score, although not usable for testing purposes, placed my accuracy at around 90%. Immediately after the test, a change that took less than five minutes to make and implement corrected the problem.

a) At the NVRA RVR testing in November 1999 in Athens, Georgia, I believe the only thing that prevented me from certifying was dictation errors from my own nervousness.

b) While I was unsure of whether I could pass the MCRA Certified Realtime Reporter (CCR) exam, once the test had been given, I realized it was possible for me to pass at that time.

There are differences in methods between stenotype and speech recognition systems regarding building vocabularies and setting up systems which will need to be addressed to fully exploit the capabilities of speech recognition to its fullest. These differences are primarily in the way vocabularies are built and how words are trained. We plan to address this issue before the next MCRA testing session.

Regardless of preparatory methods, the test was given at a slower pace than I had expected. Because I had more time than I was used to for dictation, I overenunciated words during my dictation, which actually decreased my accuracy. It was after that test that I learned that, just as reporting fast proceedings requires changes in my style of dictation, so does reporting slower proceedings. Fortunately, little compensation is

required to accommodate slower proceedings. I feel confident that I will be able to receive this certification in the future.

Reporter 3:   1.) The voice-recognition systems allow for vocabulary editing and building, which the stenotype realtime systems do not. Also, realtime tests centered around stenotye, as was the MCRA test, employ less syllabically dense wording than do realtime tests centered around voice recognition. By the very nature of the tests, the stenotype test participants receive greater recognition with less dense wording and the voice-recognition test participants receive greater recognition with more dense wording. Because of this, the sight participants were not ready for a test built around stenotype and the test built around stenotype was not ready for the sight participants.

2.) The NVRA tests were built around voice-recognition technology and were very capable of being passed by anyone who had sufficiently trained their system. The North Carolina test being the very first voice-recognition realtime certification ever, I believe the test participants were somewhat overly stressed just because of the occasion. They also had less time to train their systems than they did at the time of the Georgia certification. I received a score of 93.26% on the North Carolina test and a score of 96.11% on the Georgia test. I feel the improved score was due in part to already having one test under my belt, so to speak, and also due to the additional one month I had to continue training my system.

10.   a.) Would you be comfortable in providing a live feed to the bench and/or attorneys?

Reporter 1:   Later, yes. Now, no.

Reporter 2:   Yes, if the attorneys were educated as to what a live feed is and how it can be used, and if the judge was willing to control the proceedings.

Reporter 3:   At the current time, I would feel somewhat comfortable in providing a realtime feed to the bench and/or attorneys.

b.)What concerns do you have about providing a live feed?

Reporter 1:   Accuracy of recognition.

Reporter 2:   Lack of education of the parties creating confusion, the court not controlling the proceedings, system and misrecognition being construed as reporter error.

Reporter 3:   1.) I believe that I am currently hitting a technology wall in my recognition. The system I am using is a Petium II, 450 MgH processor,

256 Mg RAM, employing Dragon and Microsoft software that was designed for Pentium II technology. AudioScribe is currently releasing a Pentium III, 800 MgH processor, 384 Mg RAM, employing Dragon and Microsoft software that is specifically designed for Pentium III and USB technology. Any comparison between the systems is almost nonexistent.

2.) I would feel very comfortable in providing a live feed if I were able to upgrade the system to the current state of technology and then to train the system further on that basis.

11.   a.) Do you feel you possess the necessary skill level to provide meaningful access to a hearing-impaired individual?

Reporter 1:   Not now, but I expect to in the future when my system is behaving properly.

Reporter 2:   Yes.

Reporter 3:   Absolutely.

b.)What concerns do you have?

Reporter 1:   Accuracy.

Reporter 2:

- ✓ Media feeds to news with errors.

- ✓ My realtime record being used erroneously as official record.

- ✓ Viewers becoming confused because of system misrecognition.

Although we have not yet attempted it, I believe that two reporters working together, with one scoping the realtime feed before feeding it to viewers has potential to produce an extremely accurate realtime record. This concept will probably ultimately be the best situation for courts needing consistent realtime for hearing- and sight-impaired individuals. The equipment to do this is available now, but we simply have not had the chance to try it ourselves. We hope to do so in March of this year.

Reporter 3:   The limitation of the current system has nothing to do with skill, but it has everything to do with the technology existing at the time the system was built. The only concern is that of finding funding to continue to pursue 100% realtime recognition. That is my utmost desire at this time in my career, and the grant participants feel they are

fully capable of attaining that goal if allowed the tools necessary to do so.

12.   What are your concerns about the environment in which you provide this service? a.) Noise

Reporter 1:   I expect I will encounter typical courtroom noise and just have to deal with it at the time.

Reporter 2:   Noise is one of the factors I covered in 7(a) and (b). The stress of straining to hear every word being spoken in a hearing because of a noisy environment significantly reduces a reporter's endurance and degrades the quality of the record. If I am in a noisy environment, my ability to hear what is going on in front of me is clearly diminished, affecting my dictation performance, which, in turn, negatively affects speech recognition.

Reporter 3:   With the advancement of digital microphone and USB technology, this concern is relatively small. Ambient noise was a problem at first, but with better recognition, this is now a minimal problem.

b.) Physical placement of reporter and parties

Reporter 1:   This is important and will depend on my role, whether I am serving as official court reporter or providing realtime services to one specific hearing-impaired person.

Reporter 2:   Party placement is one of the factors I again covered in 7(a) and (b). Like a noisy environment, poor party placement creates the same stress and errors as in 12(a) above. Seeing and hearing all participating parties is the best situation all parties in court can have. A well-designed courtroom will place the parties so that the reporter is preferably near the witness and can see clearly, without physical obstructions, the judge and respective parties. When such arrangements are made, the reporter and all other participants hear better. Additionally, if there is a soft-spoken party or witness that the reporter is not hearing well, possibly seeing the person speak will be enough for the reporter to be able to understand what was said and not have to interrupt the record. Minimally, in courtrooms where it is either impractical or too expensive to relocate courtroom fixtures, a PA system could compensate for the reporter not being able to see and/or hear, although it must then be properly maintained to be effective as a resource.

Reporter 3:   This has always been of concern to the court reporter, but no more so with this system than ever before.

c.) Rate of speech of participants

Reporter 1:   This is the single most critical aspect affecting recognition.

Reporter 2:   I again touched on this issue in 7(a) and (d). I will here reiterate that high rates of speech used to be considered one of the unique characteristics of voice method reporters. It was a matter of pride for many a reporter to be able to take proceedings at breakneck speeds, but it came at a cost. The price the reporter paid was later having to go back and transcribe that record hoping he/she could understand themselves at high rates of dictation without having to resort to backup recordings. Or, worse yet, to have missed something altogether in the raucous proceedings. This was a cost of great time and stress trying to decipher, "What did I say?" by replaying the tape over and over for long periods of time.

Reporter 3:   The environment we are in today is much more demanding than just a few short years ago. Stenotype CAT reporters have required, demanded, and received, reasonably-paced proceedings for many years. If a reporter is expected to produce transcripts quickly, they must be given an environment that allows them to perform their job in a reasonable manner. When the requisite conditions do not exist, record quality suffers no matter what method of reporting is being used.

Reporter 3:   This is absolutely imperative. Our evaluation testing results and my personal experience in the courtroom during the grant study show that at speeds under 200 words per minute the system is almost flawless. The rate of recognition drops in direct relation to rates of speech in excess of 200 words per minute. Judges and attorneys must be cognizant of this fact and act accordingly if they are to take full advantage of all of the possibilities of realtime recognition. Both stenotype and voice-recognition certification are given at speeds of 180 to 200 words per minute. It seems inconceivable that you would certify an individual under a given set of circumstances and then expect them to perform just as well in a totally different environment. This grant participant has also found that court proceedings are more structured and meaningful to those involved while conducted in the 180-200 wpm range, anyway.

Once again, this is absolutely one of the most important aspects to be addressed if realtime reporting is to be employed in our judicial system.

SURVEYS OF PILOT COURT JUDGES

Overall, the comments of the three judges were positive. However, all three realized the technology is rapidly advancing and improvements need to continue. The following are some specific summaries of their responses.

Two of the three judges had seen the new system in operation at least once on a monitor on their bench. The third judge reported not observing a monitor to evaluate the new system during an actual hearing. However, he had seen it demonstrated by the court reporter.

All three judges responded favorably when asked if they saw potential for the technology in their court. Judges cited examples such as meeting ADA compliance, having an immediate record to help rule on objections, etc. One judge was reluctant to respond too favorably at this time believing the technology needs to continue to improve before it becomes of significant help.

All three judges indicated that they believed that the faster the proceeding the more errors occurred in voice recognition. When asked if they found problems in the pilots that affected proceedings in their court, all three judges responded with different degrees of positives and negatives. The comments on implementation of this technology ranged from "somewhat distracting" to "no negative effects."

Two of the three judges responded yes when asked if they would use the systems to meet ADA requirements. In fact, one judge planned to use the system in a few months for a case with a hearing impaired person. He also cited the costs associated with hiring sign language interpreters could be affected positively, provided the parties were happy with the realtime feeds. In addition, the realtime feed may not require the judge to stop the hearings as often, as is usually the case when sign language interpreters need a break. One judge did not believe that the realtime record produced was accurate enough at this time.

In summary, judges were positive about the pilot experience and or the potential for future development. There were some negatives, which was to be expected when implementing a new technology into a court setting. The negatives were primarily restricted to accuracy of the record, especially if the court reporters needed the proceedings to slow down to help increase accuracy.

Additional comments made by one judge also saw residual benefits for attorneys. Even if a certified record of a proceeding is not available at the end of each day, it may be helpful for a non-certified copy of a realtime transcript to be available to help attorneys. Since realtime certification requires 96 percent accuracy, providing realtime transcripts immediately upon completion of each hearing could be a viable option.

LIVE TESTING OBSERVATIONS AND FOCUS GROUP RESULTS

The following summarizes the focus group discussion following the live multimedia courtroom demonstration.

The primary participants included the judge, lawyers representing the state, natural mother and the child in the termination of parental rights case. Also present were representatives of OSCA and one member of the evaluation team from the University of Missouri.

A large screen was placed in the courtroom so that it was visible to the individuals participating in the case. The judge had his own monitor. Using the screen, each participant could view the transcript as it was projected (realtime) by the system. The transcription was the immediate voice recognition text of the spoken words of the court reporter into the stenomask. Since the system does not correctly identify all of the sounds, what the participants saw included some errors.

All participants involved agreed that the multimedia projection created a distraction. However, they also agreed that this was the first time they had participated in such a proceeding and that if they were accustomed to the technology, it would not be such a distraction. Also, in the future when the new system is in everyday use there could be several small monitors for interested parties rather than one large one. The judge commented that the system was very helpful to him since he could quickly look back to help recall the specific wording of an item he had to make a ruling on.

It was also noted by all of the participants that being able to obtain a copy of the day's proceedings to take home at night would be extremely helpful, even though the copy would not be an official transcript. The proceedings as transcribed are time stamped, thus, making it quite easy to locate particular pieces of testimony.

All of the participants agreed that the new system would be very helpful to the hearing impaired. They indicated that signers for hearing impaired individuals create as much of a distraction as the multimedia projection would. One participant was concerned that the judge would be distracted because of the presence of a monitor on his desk.

It appears that the two primary positive things for the new system are the ability to produce a copy of the proceeding quickly and the aid it provides for the hearing impaired. The only negative item was the distraction created by the projection method used in the live multimedia test. However, when considered against the distraction of an interpreter, it may prove to be insignificant.

REALTIME TESTS

When you review the goals of this project, there is no doubt that realtime reporting ranked as the ultimate goal for this demonstration. Passage of

the National Verbatim Reporters Association (NVRA) realtime test became a reality for one of the three pilot court reporters.

The evaluation did not consider the learning curve for a stenotypist to become realtime proficient nor did it construct any comparison to the learning curve for this stenomask technology. However, it may be that the realtime certification of one and close to passing scores of the other two pilot participants within one year of obtaining this technology is probably a significant achievement.

According to the NVRA, to obtain realtime certification, a reporter must pass with at least a 96 percent on the realtime test. One pilot reporter passed their test with a score of 96.11 percent and the other two received scores of 94.63 and 90.21 percent. This is the nation's first realtime certified stenomask court reporter. Obviously, this component of the evaluation proved highly successful.

CONCLUSIONS

Although each of the court reporters involved in the experiment listed difficulties encountered during the learning process (i.e., both hardware and software problems), they all conclude that this technology holds a great deal of potential for stenomask court reporters and our nation's courts.

Two of the three judges also indicated strong support for the voice recognition systems. The third judge expressed dissatisfaction with the new system at its current level but also supported the continued development of the system. The feature which all individuals directly involved in the use of the new technology felt was the most useful was the ability to reproduce a non-certified copy of a proceeding quickly. A negative feature of the new technology is that fast dialogue is detrimental. This was the feature which distressed the third judge and kept him from strongly supporting the new technology. The question to be assessed is what degree proceeding speed reduction is acceptable if you are attempting to meet ADA requirements or to have faster transcript preparation?

Even though the transcript preparation time results/data does not strongly support the conjecture that the new method will result in a savings of time it is felt that as the learning process continues, such a savings in time will occur.

It is relevant to point out that the three court reporters that participated in the experiment were among the very best court reporters in the state. It remains to be seen how reporters who do not possess the skills and

experience that these three possess will perform when they use the new technology. In all fairness it needs to be pointed out that the software will continue to be improved, thus making it easier to learn how to use the new technology.

An extremely important point to include in the summary is that one of the reporters passed the realtime test. He is the first and only stenomask reporter to do this in the nation. A one sentence conclusion which could be drawn from this project would be that even though there are problems associated with the new technology, all of the participants would agree that the new technology is the technology of the future for stenomask court reporters.